

TITLE OF THE INVENTION

System And Method For Executing Control Protocols
Among Nodes In Separate IP Networks

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FIELD OF THE INVENTION

The present invention relates generally to a means for running a control protocol within two IP networks that are separated by a firewall/router utilizing Network Address Translation (NAT).

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BACKGROUND OF THE INVENTION

MEGACO is a recently adopted standard (control protocol) for controlling Media Gateways (MGs) via Media Gateway Controllers (MGCs). MEGACO makes use of IP addresses explicitly contained within control messages exchanged between MGs and MGCs. Network Address Translation (NAT) is the act of changing an IP address from one IP network realm to another IP network realm where the IP networks are separated by a firewall/router. NAT is employed for such reasons as security, ease of network configuration, and a lack of IP addresses. Thus, in a configuration of two different IP networks separated by a firewall/router, NAT is used to ensure that IP packets reach their intended destinations. MEGACO currently will not function properly across different IP networks, however, because the IP addresses embedded in MEGACO messages are not subjected to NAT.

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What is needed is a mechanism for allowing the firewall/router separating the IP networks to inspect and translate the IP addresses within MEGACO message packets during the NAT procedure. Such a mechanism would allow an

MGC in one IP network to control an MG in another IP network.

SUMMARY OF THE INVENTION

5 The present invention comprises systems and methods for ensuring that the control protocols (e.g., MEGACO) can be used between Media Gateways (MGs) and Media Gateway Controllers (MGCs) that reside on separate IP networks. Network Address Translation (NAT) is strategically
10 implemented to inspect and translate control protocol messages exchanged between nodes on separate IP networks.

Two methodologies for inspecting and translating control protocol messages are presented herein. One is to add NAT intelligence to a firewall/router giving the
15 firewall/router the ability to inspect and translate IP addresses within control protocol messages. Another is to have a firewall/router forward control protocol messages to a separate NAT server to inspect and translate the IP addresses within control protocol messages. The former
20 implementation places a significant amount of real-time work on the firewall/router which can affect its performance of its core duties. The latter implementation does not affect performance but requires deploying additional hardware. Thus, the former implementation is
25 advantageous when firewall/router performance is not critical since it is more cost effective while the latter implementation is advantageous when performance is critical. Regardless of the implementation chosen the methodology is essentially the same, namely, using Network

In accordance with a first embodiment of the invention is a device for translating IP addresses of control protocol messages sent between nodes on separate IP networks. The device receives a control protocol message from a node on a first IP network and translates IP addresses within the control protocol message from the IP address domain of the first IP network to an IP address domain of another IP network. The device then routes the control protocol message to a node on the second IP network.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE FIGURES

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Gateway discovery using the implementation in which an enhanced firewall / NAT router translates IP addresses

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DETAILED DISCLOSURE OF THE INVENTION

Network Address Translation (NAT) allows hosts in a private computer network to transparently communicate with destinations on an external computer network and vice versa. NAT devices provide a transparent routing solution to end nodes that are resident on separate networks having different address schemes. This is achieved by modifying end node addresses while data is en-route between network realms and maintaining state information for these modifications so that datagrams pertaining to a communication session are routed to the proper end node in both network realms. Modification will typically occur at a firewall that separates the private network from the external network. The firewall is typically part of and under the control of the private network. The firewall commonly takes on routing functions as well.

NAT is commonly used for a variety of reasons. Probably the most important of which is a lack of IP addresses. NAT is extremely powerful in that the private network may have only one (1) valid external (Internet) address, it can maintain up to 16 million internal IP addresses on the private network. This gives 16 million end nodes in the private network the ability to communicate with external network nodes. Moreover, if the other end node represents another private network with NAT capability, even more end nodes can be reached. Another compelling reason for NAT is the security it provides. By implementing NAT, private network configuration is kept secret to the outside world. Yet another reason to use NAT is its ease of configuration. Even if there is an external

network change, private network configuration maintains the same internal IP address configuration.

MEGACO is a control protocol that is used by a Media Gateway Controller (MGC) to control at least one Media Gateway (MG). MGs include resources (terminations) that can be identified by IP addresses. When an MGC communicates with an MG using MEGACO, the MEGACO messages carry IP addresses corresponding to specific resources within the MG. One possible configuration is that of a Media Gateway Controller (MGC) in a different network than a Media Gateway (MG) that it controls where they are connected by IP Network Address Translation (NAT). In such a configuration MEGACO messaging will fail because the IP addresses within the MEGACO messages will not be translated by the NAT device. The solution is to enhance the firewall/NAT router by giving it the ability to inspect and translate IP addresses within MEGACO messages or to have the firewall/NAT router offload the MEGACO messages to a special MEGACO NAT server for IP address translation.

The present invention is described with reference to MEGACO as the control protocol. It is to be understood that the present invention will function for any control protocol having embedded IP addresses in the messaging. Thus, the description of MEGACO is illustrative and not intended to limit the scope of the present invention.

FIGURE 1A illustrates a network architecture in which a Media Gateway Controller (MGC) in one IP network controls a Media Gateway (MG) in another IP network. **FIGURE 1A** uses an enhanced firewall / NAT router implementation to translate the IP addresses within MEGACO messages. A Media

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router **160** offloads all MEGACO messages entering and leaving IP network **120** to MEGACO NAT server **170** for inspection and translation of IP addresses within MEGACO messages.

- 5 **FIGURE 2A** illustrates MEGACO messaging used for MG discovery using the implementation in which an enhanced firewall / NAT router translates the IP addresses within the MEGACO messages.

10 In the MEGACO protocol, when an MG becomes available, it registers itself with its MGC using a *Service Change* message. The NAT device (the firewall in this case) listens on a MEGACO port and determines that an MG is becoming available when it receives the *Service Change* message. The NAT device then can place the IP address of
15 the MG into its own NAT table of IP addresses.

20 The corresponding messaging among the MGC **110**, firewall **160**, and MG **140** is as follows. MG [10.12.2.2] **140** sends a MEGACO *Service Change* message **210** to its MGC **110**. The message is received by firewall / NAT **160** which is
25 listening on a MEGACO port having an IP address of [10.2.2.50]. The firewall / NAT **160** then inspects the *Service Change* message and changes the IP address of the MG from {10.12.2.2} to [175.17.4.1] **220**. [175.17.4.1] is the IP address of the firewall / NAT **160** according to the
30 private IP network **120**. The change is entered in the NAT table maintained by the firewall /NAT **160**. Next, the firewall / NAT **160** sends the MEGACO *Service Change* message **230** to the MGC **110** using the substitute IP address. The MGC **110** responds with a *Service Change Reply* message **240** containing its IP address. The firewall /NAT **160** relays

FIGURE 2B illustrates the same MEGACO used for MG discovery messaging as in **FIGURE 2A** except that an additional server **170** operatively connected to the firewall / NAT router **160** translates the IP addresses within the MEGACO messages. This time when the firewall **160** receives a MEGACO *Service Change message 210* it is automatically off-loaded to a MEGACO / NAT server **170**. The MEGACO / NAT server **170** then inspects and translates any IP addresses contained in the message and sends the message back to the firewall **160** with translated IP addresses as represented by message pair **215, 225**. The firewall **160** then routes the messages accordingly.

If the message is a Service Change message (as in this case) then the MEGACO NAT server **170** will query the translation rules of the firewall (messaging not shown). Upon receipt of a response regarding the translation rules, the MEGACO NAT server **170** stores the IP translation rules in its own NAT table(s). No more queries are needed after the initial query.

This walk through assumes that the MG (10.12.2.2.2) **140** has already registered with the MGC (175.1.1.1) **110** via a *Service Change message* as previously described in **FIGURES 2A** and **2B**. Moreover, not every message used in a call (e.g., Acknowledgment messages) is shown in this walkthrough. The illustration describes the processes of

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When the MG **140** receives the MEGACO *Modify message* having signal components of DialTone and CollectDigits it responds back to the MGC **110** with a MEGACO *Notify message* **330** having a component of ObservedEvent = CollectedDigits. Again, the message is received into the firewall /NAT **160** and a NAT IP address substitution takes place **335** ensuring that the message reaches **340** the MGC **110** with an IP address that it can understand. The MGC **110** responds with MEGACO *Add message* **345** which is passed through the firewall **350** to the MG. The MG **140** responds with a MEGACO *Reply to Add message* **355** which undergoes IP address translation **360** in the firewall / NAT **160** prior to reaching **365** MGC **110**.

It is to be understood that the present invention illustrated herein is readily implementable by those of ordinary skill in the art as a computer program product having a medium with a computer program embodied thereon.

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a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instruction means which implement the function specified in the flowchart block(s). The computer
5 program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which
10 execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block(s) or message diagram(s).

Accordingly, block(s) of flowchart illustrations or message diagram(s) support combinations of means for
15 performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block of flowchart illustrations or message diagram, and combinations of
20 blocks in flowchart illustrations, or message diagrams can be implemented by special purpose hardware-based computer systems that perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

25 In the following claims, any means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is
30 illustrative of the present invention and is not to be

construed as limited to the specific embodiments disclosed,
and that modifications to the disclosed embodiments, as
well as other embodiments, are intended to be included
within the scope of the appended claims. The invention is
5 defined by the following claims, with equivalents of the
claims to be included therein.

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